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SAFETY NOTICE

SUBJECT:

Standard Operating Procedures for Flight Crew Members

GENERAL: Safety Notices (SNs) are issued by the Civil Aviation Authority – Macao, China to convey advisory information to Macao aviation entities to enhance safety. SNs contain safety-related recommendations, guidance and/or industrial best practices to specific subjects which may or may not have been addressed by established requirements and regulations.

RELATED REGULATIONS: AC/OPS/025 – Training and Testing Requirements for Flight Crew Member and Flight Operations Officer
AC/OPS/002 – Operations Manual Requirements

APPLICABILITY: This SN applies to all Macao air operators.

CANCELLATION: This SN is the first SN issued on this subject.

REFERENCES: The following material was referred to for the development of this SN:

- ICAO Regional Aviation Safety Group – Asia and Pacific Regions (RASG-APAC) endorsed safety tools – Standard Operating Procedures for Flight Deck Crewmembers

1. Introduction

1.1 Standard Operating Procedures (SOPs) are universally recognized as being basic to safe aviation operations. Effective crew coordination and crew performance, two central concepts of Crew Resource Management (CRM), depend upon the crew's having a shared mental model of each task. That mental model, in turn, is founded on SOPs.

1.2 This Safety Notice is issued to present background, basic concepts, and philosophy in respect to SOPs and provide advice and recommendations in order to develop, implement and update SOPs with detailed guidance included in the Appendices of this SN.

2. Background

2.1 For many years the ICAO has identified deficiencies in SOPs as contributing causal factors in aviation accidents. Among the most commonly cited deficiencies involving flight crews has been their noncompliance with established procedures, another has been the non-existence of established procedures in some manuals used by flight crews.

2.2 The ICAO has recognized the importance of SOPs for safe flight operations and required SOPs for each phase of flight shall be contained in the operations manual used by flight crews. Many aviation safety organizations have concluded that air operators perform with higher levels of safety when they establish an adhere to adequate SOPs.

2.3 The ICAO Regional Aviation Safety Group – Asia and Pacific Regions (RASG-APAC) endorsed a safety tool which presents background, basic concepts, and philosophy in respect to SOPs while it emphasizes that SOPs should be clear, comprehensive and readily available in the manuals used by flight crew members.

3. Scope

3.1 This SN consolidates many topics viewed as important to be addressed as SOPs in air operator training programs and in the manuals used by air operator flight crew members. While the information in this SN relates to SOPs in general, it contains specific information relating to SOPs for Controlled Flight into Terrain (CFIT) and Loss of Control In-flight (LOC-I). It is important to note that this SN does not list every important SOP topic or dictate exactly how each topic should be addressed by an air operator. Instead, this SN offers a baseline of topics to be used as a reference. In practice, each air operator's manuals and training programs are unique. Each air operator could omit certain topics shown in the template when they do not apply, and on the other hand could add other topics not shown in the template when they do apply.

3.2 Air operators should make reference to the aircraft manufacturer's recommended procedures in order to develop comprehensive SOPs for training programs and manuals for their flight crew members.

4. Effective Application of the SOPs

Applying the SOPs Template and Other Appendices

4.1 Generally, each SOP topic identified in the template in Appendix 1 to this SN is important and should be addressed in some manner by air operator, if applicable. Stabilized approaches in Appendix 2 to this SN is a particularly important area where SOPs are critical to safe flight operations. Other important areas for sound SOPs, such as those associated with specific approvals or with new technologies, are not shown in the template, but should be addressed as well, when applicable. Because each air operator's operation is unique, developing the specific manner in which SOPs are addressed is the task of the air operator. Topics expanded and illustrated in the Appendices are for example only, and represent renditions of SOPs known to be effective. An SOP topic shown in the Appendices may be addressed in detail, including text and diagrams, or in very simple terms. For example, an SOP may be addressed in a simple statement such as "ABC Airlines does not conduct Category III approaches".

Key Features of Effective SOPs

4.2 Many experts agree that implementation of any procedures as an SOP is most effective if:

(a) The procedure is appropriate to the situation.

(b) The procedure is practical to use.

(c) Crew members understand the reasons for the procedure.

(d) Pilot Flying (PF), Pilot Monitoring (PM), and Flight Engineer duties are clearly delineated.

(e) Effective combined means of information dissemination, through descriptive circulars (electronic or paper), courses (virtual or classroom) and line or scenario based simulator training, is conducted.

(f) Collective endorsement and continuous review of a new procedure by all stakeholders is fundamental to successful implementation and effective operations.

(g) The procedure should be equipped with redundancy and thereby not limiting. This will permit crews a degree of lateral flexibility when managing non-normal scenarios.

4.3 The above seven elements are further reinforced by effective Crew Resource Management (CRM) skills, such as task sharing and communication, as well as a disciplined approach towards checklist philosophy. A process of continual open feedback, review and modification of all procedures will serve to enhance the organization's overall level of safety.

The Importance of Understanding the Reasons for an SOP

4.4 Effective Feedback. When flight crew members understand the underlying reasons for an SOP they are better prepared and more eager to offer effective feedback for improvements. The air operator, in turn, benefits from more competent feedback in revising existing SOPs and in developing new SOPs. Those benefits include safety, efficiency and employee morale.

4.5 Troubleshooting. When flight crew members understand the underlying reasons for an SOP, they are generally better prepared to handle a related in-flight problem that may not explicitly or completely addressed in their operating manuals.

Collaborating for Effective SOPs

4.6 In general, effective SOPs are the product of healthy collaboration among managers and flight operations personnel, including flight crews. A safety culture promoting continuous feedback from flight crew and others, and continuous revision by the collaborators distinguishes effective SOPs at air operators of all sizes and ages.

4.7 New air operators adding a new aircraft fleet, or air operators retiring one aircraft fleet for another must be especially diligent in developing SOPs. Stakeholders with applicable experience may be more difficult to bring together in those instances.

4.8 For a startup air operator, this SN and its Appendices should be especially valuable tools in developing SOPs. The developers should pay close attention to the approved Airplane Flight Manual (AFM), to

AFM revisions and operations bulletins issued by the manufacturer. Desirable partners in the collaboration would certainly include representatives of the airplane manufacturer, pilots having previous experience with the airplane or with the kind of operations planned by the operator. The development of SOPs should maintain a close parallel with ICAO Safety Management System (SMS) principles in that the process is subjected to constant open feedback, review and modification from all stakeholders. Together, managers and flight crews are able to review the effectiveness of SOPs and to reach valid conclusions for revisions.

4.9 An existing air operator introducing a new airplane fleet should also collaborate using the best resources available, including the AFM and operations bulletins. Experience has shown that representatives of the airplane manufacturer, managers, check pilots, instructors, and line pilots work well together as a team to develop effective SOPs. A trial period might be implemented, followed by feedback and revision, in which SOPs are improved. By being part of an iterative process for changes in SOPs, the end user, the flight crew member, is generally inclined to accept the validity of changes and to implement them readily.

4.10 Long-established air operators should be careful not to assume too readily that they can operate an airplane recently added to the fleet in the same standard way as older types or models. Managers, check pilots and instructors should collaborate using the best resources available, including the AFM and operations bulletins to ensure that SOPs developed or adapted for a new airplane are in fact effective for that aircraft, and are not inappropriate carryovers.

5. Recommended Actions

5.1 Air operators are encouraged to note the information contained in this Safety Notice and review their policies, procedures and training to reflect the safety issues contained in this SN.

- End -

APPENDIX 1

STANDARD OPERATING PROCEDURS TEMPLATE

A manual or section in a manual serving as the flight crew's guide to standard operating procedures (SOPs) may double as a training guide. The content should be clear and comprehensive, without necessarily being lengthy. No template could include every topic that might apply unless it was constantly revised. Many topics involving specific approvals or new technology are absent from this template, the following are nevertheless viewed as examples of topics that constitute a useful template for developing comprehensive and effective SOPs:

List of Topics

1. Captain's authority

2. Use of automation

    (1) The operator's automation philosophy

    (2) Specific guidance in selection of appropriate levels of automation autopilot/flight director mode control inputs

    (3) Flight management systems inputs

3. Checklist philosophy

    (1) Policies and procedures (Who calls for; who reads; who does)

        (a) Checklist interruptions

        (b) Checklist ambiguity

        (c) Checklist couplings

        (d) Checklist training

    (2) Format and terminology

    (3) Type of checklist

        (a) Challenge-Do-Verify

        (b) Do-Verify

    (4) Walk-arounds

4. Checklists

    (1) Safety check – power on

    (2) Originating/receiving

    (3) Before start

    (4) After start

    (5) Before taxi

    (6) Before take-off

    (7) After take-off

    (8) Climb check

    (9) Cruise check

    (10) Preliminary landing

    (11) Landing

    (12) After landing

    (13) Parking and securing

    (14) Emergency procedures

    (15) Non-normal/abnormal procedures

5. Communications

    (1) Who handles radios

    (2) Primary language used

        (a) ATC

        (b) On the flight deck

    (3) Keeping both pilots in the loop

    (4) Company radio procedures

    (5) Flight deck/cabin signals

    (6) Cabin/flight deck signals

6. Briefings

   (1) CFIT risk considered

   (2) Special airport qualification considered

   (3) Temperature corrections considered

   (4) Before takeoff

   (5) Descent/approach/missed approach

   (6) Approach briefing generally done prior to beginning of descent

   (7) Flight deck access

   (8) On ground/in flight

   (9) Jumpseat

   (10) Access signals, keys

7. Flight deck discipline

   (1) Sterile cockpit

   (2) Maintaining outside vigilance

   (3) Monitoring/cross checking

   (4) Transfer of control

   (5) Additional duties

   (6) Flight kits

   (7) Headsets/speakers

   (8) Boom mikes/handsets

   (9) Maps/approach charts

   (10) Meals

8. Altitude awareness

   (1) Altimeter settings

   (2) Transition level

(3) Callouts (verification of)

(4) Minimum safe altitudes (MSA)

(5) Temperature corrections

(6) Monitoring during last 1000 feet of altitude change

9. Report times

(1) Check in/show up

(2) On flight deck

(3) Checklist accomplishment

10. Maintenance procedures

(1) Logbooks/previous write-ups

(2) Open write-ups

(3) Notification to maintenance of write-ups

(4) Minimum Equipment List (MEL)

(5) Where it is accessible

(6) Configuration Deviation List (CDL)

(7) Crew coordination in ground de-icing

11. Flight plans/dispatch procedures

(1) VFR/IFR

(2) Icing considerations

(3) Fuel loads

(4) Weather package

(5) Where weather package is available

(6) Departure procedures climb gradient analysis

12. Boarding passengers/cargo

(1) Carry-on baggage

(2) Exit row seating

(3) Hazardous materials

(4) Prisoners/escorted persons

(5) Guns onboard

(6) Count/load

13. Pushback/powerback

14. Taxiing

    (1) All engines running

    (2) Less than all engines running

    (3) On ice or snow or heavy rain

    (4) Low visibility

    (5) Prevention of runway incursion

15. Crew Resource Management (CRM)

    (1) Crew briefings

        (a) Cabin crew

        (b) Flight crew

16. Weight and balance/cargo loading

    (1) Who is responsible for loading cargo and securing cargo

    (2) Who prepares the weight and balance data form; who checks it

    (3) Copy to crew

17. Flight /cabin crew interchange

    (1) Boarding

    (2) Ready to taxi

    (3) Cabin emergency

    (4) Prior to take-off/landing

18. Takeoff

    (1) Pilot Flying (PF)/Pilot Not Flying (PNF) duties and responsibilities

    (2) Who conducts it?

    (3) Briefing, IFR/VFR

    (4) Reduced power procedures

    (5) Tailwind, runway clutter

    (6) Intersections/land and hold short procedures (LAHSO)

    (7) Noise abatement procedures

    (8) Special departure procedures

    (9) Flight directors

        (a) Use of: Yes/No

    (10) Callouts

    (11) Clean up

    (12) Loss of engine

        (a) Transfer of controls – if appropriate

        (b) Rejected takeoff

        (c) After V1

        (d) Actions/callouts

    (13) Flap settings

        (a) Normal

        (b) Nonstandard and reason for

        (c) Crosswind

    (14) Close-in turns

19. Climb

    (1) Speeds

(2) Configuration

(3) Confirm compliance with climb gradient required in departure procedure

(4) Confirm appropriate cold temperature corrections made

20. Cruise altitude selection

(1) Speeds/weights

21. Position reports/pilot weather reports

(1) ATC – including pilot report of hazards such as icing, thunderstorms and turbulence

(2) Company

22. Emergency descents

23. Holding procedures

(1) Procedures for diversion to alternate

24. Normal descents

(1) Planning and discussing prior to beginning of descent point

(2) Risk assessment and briefing

(3) Speedbrakes: Yes/No

(4) Flaps/gear use

(5) Icing considerations

(6) Convective activity

25. Ground Proximity Warning System (GPWS) or Terrain Awareness Warning System (TAWS)

(1) Escape maneuver

26. Traffic Alert and Collision Avoidance System (TCAS)

27. Windshear

(1) Avoidance of likely encounters

(2) Recognition

(3) Recovery/escape maneuver

28. Approach philosophy

    (1) Monitoring during approaches

    (2) Precision approaches preferred

    (3) Stabilized approaches standard

    (4) Use of navigation aids

    (5) Flight Management System (FMS)/autopilot

    (6) Use and when to discontinue use

    (7) Approach gates

    (8) Limits for stabilized approaches

    (9) Use of radio altimeter

    (10) Go-around: plan to go around; change plan to land when visual, if stabilized

29. Individual approach type

    (1) All types, including engine-out

30. For each type of approach

    (1) Profile

    (2) Airplane configuration for conditions

        (a) Visual approach

        (b) Low visibility

        (c) Contaminated runway

    (3) Flap/gear extension

    (4) Auto spoiler and auto brake systems armed and confirmed armed by both pilots, in accordance with manufactures recommended procedures (or equivalent company procedures)

    (5) Procedures – actions and callouts

31. Go-around/missed approach

    (1) When stabilized approach gates are missed

    (2) Procedure – actions and callouts clean-up profile

32. Landing

    (1) Actions and callouts during landing

    (2) Close-in turns

    (3) Crosswind

    (4) Rejected

    (5) Actions and callouts during rollout

    (6) Transfer of control after first officer landing

APPENDIX 2

STABILIZED APPROACH: CONCEPTS AND TERMS

A stabilized approach is one of the key features of safe approaches and landings in air operator operations, especially those involving transport category airplanes.

A stabilized approach is characterized by a constant-angle, constant-rate of descent approach profile ending near the touchdown point, where the landing maneuver begins. A stabilized approach is the safest profile in all but special cases, in which another profile may be required by unusual conditions.

All appropriate briefings and checklists should be accomplished before 1000’ height above threshold (HAT) in Instrument Meteorological Conditions (IMC), and before 500’ HAT in Visual Meteorological Conditions (VMC).

Flight should be stabilized by 1000’ height above threshold (HAT) in Instrument Meteorological Conditions (IMC), and by 500’ HAT in Visual Meteorological conditions (VMC). An approach that becomes unstabilized below the altitudes shown here requires an immediate go-around.

An approach is stabilized when all of the following criteria are maintained from 1000’ HAT (or 500’ HAT in VMC) to landing in the touchdown zone:

a. The airplane is on the correct[1] track.

b. The airplane is in the proper landing configuration.

c. After glide path intercept, or after the Final Approach Fix (FAF), or after the derived fly-off point (per Jeppesen) the pilot flying requires no more than normal bracketing corrections[2] to maintain the correct track and desired profile (3° descent angle, nominal) to landing within the touchdown zone. Level-off below 1000’ HAT is not recommended. The airplane speed is within the acceptable range specified in the operating manual used by the pilot.

d. The rate of descent is no greater than 1000 fpm.

    i. If an expected rate of descent greater than 1000 fpm is planned, a special approach briefing should be performed.

    ii. If an unexpected, sustained rate of descent greater than 1000 fpm is encountered during the approach, a missed approach should be performed. A second approach may be attempted after a special approach briefing, if conditions permit.

e. Power setting is appropriate for the landing configuration selected, and is within the permissible power range for approach specified in the operating manual used by the pilot.

Vertical guidance: Vertical guidance may be provided to the pilot by way of an electronic glideslope, a computed descent path displayed on the pilot's navigation display, or other electronic means. On approaches for which no vertical guidance is provided, the flight crew should plan, execute and monitor the approach with special care, taking into account traffic and wind conditions. To assure vertical clearance and situation awareness, the pilot not flying should announce crossing altitudes as published fixes and other points selected by the flight crew are passed. The pilot flying should promptly adjust descent angle as appropriate. A constant-angle, constant-rate descent profile ending at the touchdown point is the safest profile in all but special cases.

Visual contact. Upon establishing visual contact with the runway environment, the pilot should be able to continue to a safe landing using normal bracketing corrections, or, if unable, should perform a missed approach.

No visual contact. The operator may develop procedures involving a standard MDA buffer altitude or other procedures to assure that descent below MDA does not occur during the missed approach. If no visual contact is established approaching MDA or a MDA buffer altitude, or if the missed approach point is reached, the pilot should perform the published missed approach procedure. Below 1000' HAT, leveling off at MDA (or at some height above MDA) is not recommended, and a missed approach should be performed.

Note 1: A correct track is one in which the correct localizer, radial, or other track guidance has been set, tuned, and identified, and is being followed by the pilot.

Note 2: Normal bracketing corrections related to bank angle, rate of descent, and power management. Recommended ranges are as follows (operating limitations in the approved airplane flight manual must be observed, and may be more restrictive):

Course guidance	Specific types of approach are stabilized if they also fulfill the following: Instrument Landing Systems (ILS) must be flown within +/- one (1) dot of the glideslope and localizer; Category II or Category III ILS approach must be flown within the expanded localizer band; during a circling approach, wing should be level on final when the aircraft reaches 300 feet above the airport elevation; and Unique approach procedures for abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing. The use of flight-director systems aboard Electronic Flight Instrument System (EFIS) equipped aircraft should be utilized in accordance with manufacturer and operator recommended procedures.
Bank angle	Maximum bank angle permissible during approach is specified in the operating manual used by the pilot, and is generally not more than 30°; the maximum bank angle permissible during landing may be considerable less than 30°, as specified in that manual.

Power management	Permissible power range is specified in the operating manual used by the pilot
Overshoots	Normal bracketing corrections occasionally involve momentary overshoots made necessary by atmospheric conditions. Such overshoots are acceptable. Frequent or sustained overshoots caused by poor pilot technique are not normal bracketing corrections.

APPENDIX 3

Examples

ATC COMMUNICATIONS AND ALTITUDE AWARENESS

ATC Communications: SOPs should state who handles the radios for each phase of flight and will read back to the air traffic controller the following ATC clearances and instructions and air safety related information which are transmitted by voice:

a. ATC route clearances.

b. Clearances and instructions to enter, land on, takeoff on, hold short of, cross and backtrack on any runway.

c. Runway-in-use, altimeter settings, SSR codes, level instructions, heading and speed instructions and, whether issued by the controller or contained in Automatic terminal information service (ATIS) broadcasts, transition levels.

d. Other clearances or instructions including conditional clearances shall be read back or acknowledged in a manner to clearly indicate that they have been understood and will be complied with.

e. PF makes input to aircraft/autopilot and/or verbally states clearances while PNF confirms input is what he/she read back to ATC.

f. Any confusion in the flight is immediately cleared up by requesting ATC confirmation.

g. If any crew member is off the flight deck, all ATC instructions are briefed upon his/her return. Or if any crew member is off the flight deck all ATC instructions are written down until his/her return and then passed to that crew member upon return. Similarly, if a crew member is off ATC frequency (e.g. when making a PA announcement or when talking on company frequency), all ATC instructions are briefed upon his/her return.

h. Company policy should address use of speakers, headsets, boom mike and/or hand-held mikes.

i. Company personnel should comply with all standard ATC phraseology as referenced in ICAO PANS-OPS, Annex 11 and PANS-ATM (Air Traffic Management Document 4444).

Altitude Awareness: SOPs should state the company policy on confirming assigned altitude. Typically, aboard modern EFIS when performing an altitude change, the following challenge/response confirmations should occur:

- Confirm altitude clearance with ATC via standard R/T read back requirement.
- PF to set assigned altitude on autopilot/altitude alerting panel.

- PF to confirm assigned altitude correctly set with PM via positive visual and aural identification of autopilot/altitude alerting panel. e*.g. PF: FL320 set; PM FL320 checked.*
- PF to execute climb/descent to new assigned altitude. PM to monitor the climb/descent and announce when approaching new assigned altitude (e.g. "1,000 feet to go") to direct attention of both crew to ensure the correct level-off and avert an altitude deviation.

If the aircraft is being hand-flown then the PM makes the input into the altitude alerter/autopilot, then points to the input and states clearance. PF then points to the alerter stating aloud what he/she understands the ATC clearance to be confirming that the alerter and clearance match.

Due consideration must also be given to prevailing environmental conditions (e.g. wind velocity) and the presence of other traffic in the vicinity to prevent inadvertent triggering of a TCAS alert or resolution advisory.

APPENDIX 4

Examples

CREW BRIEFINGS

Pilot Briefing

The purpose of the pilot briefing is to enhance communications on the flight deck and to promote effective teamwork. Each crew member is expected to perform as an integral part of the team. The briefing should establish a mutual understanding of the specific factors appropriate for the flight.

A pilot briefing will be given prior to starting engines for the first flight of the day (subsequent flight, if applicable). The captain (or PF) determines the length and detail of the briefing. Factors to consider include:

- Experience level of the pilots
- Special MEL procedures as a result of inoperative components
- Altimeter setting units
- Use of delayed engine start and/or engine out taxi procedure

When personnel occupy the extra crew seat(s), ensure they understand the use of oxygen/interphone operations and emergency exits, and sterile flight deck procedures.

Takeoff Briefing

A takeoff briefing will be given prior to takeoff. Examples of factors to be considered may include:

- Takeoff weather conditions
- Runway surface conditions
- NOTAMs
- Taxi route
- Departure review
- Obstructions and high terrain
- Closeout weight and balance message/takeoff numbers
- Critical conditions affection the GO/NO GO decisions (e.g. gross weight limited takeoff, wet or slippery runway, crosswind, aircraft malfunctions)
- Threat and Error Management (TEM): To include in the briefing to heighten and centralize crew situational awareness with any potential latent or active threats that may affect the operation. The management of threats is achievable through avoiding, trapping or mitigating the preemptive or consequential circumstances that are associated with a particular threat encounter. *Example of threats are: bird-strike potential, jet-blast hazards, taxiway "hotpots", TCAS TA/RA mitigation, etc.*

Cabin Crew Briefing

The purpose of the cabin crew briefing is to develop a team concept between the flight deck and cabin crew. An ideal developed team must share knowledge relating to flight operations, review individual responsibilities, share personal concerns, and have a clear understanding of expectations.

Upon flight origination or whenever a crew change occurs, the captain will conduct a verbal briefing with the Cabin-Crew in Charge (CIC) on all salient items pertaining to the conduct of the flight from an operational safety and security standpoint. The briefing delivery ought to be clear, concise and unambiguous to avoid the potential for miscommunications. Time and conditions permitting, a brief by the caption/PF to all members of the cabin crew may also be sought. However, preflight duties, passenger boarding, rescheduling, etc. may make it impractical to brief the entire cabin crew complement. Regardless of time constraints, company polity is that the captain must brief the lead cabin crew. The briefing should cover the following items:

- Logbook discrepancies that my affect cabin crew responsibilities or passenger comfort (e.g. coffee maker inoperative, broken seat backs, manual pressurization, etc.)
- Weather affecting the flight (e.g. turbulence – including appropriate code levels, thunderstorms, weather near minimums, etc.). Provide the time when the weather may be encountered rather than a distance or location (e.g. "Code 4 turbulence can be expected appropriately one hour after takeoff".)
- Delays, unusual operations, non-routine operations (e.g. maintenance delays, ATC delays, re-routes, etc.)
- Shorter than normal taxi time of flight time which may affect preflight announcements or cabin service.
- Any other items that may affect the flight operation or in-flight service such as catering, fuel stops, armed guards, etc.
- A review of the sterile flight deck policy, responsibility for PA announcements when the fasten seat belt sign is turned on during cruise, emergency evacuation commands, or any other items appropriate to the flight.
- An appropriate security briefing regarding both ground and in-flight management of potential security related events. The regulator and operator security policies and procedures must be strictly observed and adhered during the conduct of the flight.

During the briefing, the captain should solicit feedback for operational concerns (e.g. does each person understand the operation of the emergency exits and equipment). The captain should also solicit feedback for information which may affect expected team roles. Empower each crew member to take a leadership role in ensuring all crew members are made aware of any potential item that might affect the flight operation.

The lead cabin crew will inform the captain of any inoperative equipment and the number of cabin crew on board. The captain will inform the lead cabin crew when there are significant changes to the operation of the flight after the briefing has been conducted.

APPENDIX 5

Examples

CREW MONITORING AND CROSS-CHECKING

Background

Several studies of crew performance, incidents and accidents have identified inadequate flight crew monitoring and cross-checking as a problem for aviation safety. Therefore, to ensure the highest levels of safety each flight crewmember must carefully monitor the aircraft's flight path and systems and actively cross-check the actions of other crew members. Effective monitoring and cross-checking can be the last barrier or line of defense against accidents because detecting an error or unsafe situation may break the chain of events leading to an accident. Conversely, when this layer of defense is absent, errors and unsafe situations may go undetected, leading to adverse safety consequences. It is difficult for humans to monitor for errors on a continuous basis when these errors rarely occur. Monitoring during high workload periods is important since these periods present situation in rapid flux and because high workload increases vulnerability to error. However, studies show that poor monitoring performance can be present during low workload periods, as well. Lapses in monitoring performance during lower workload periods are often associated with boredom and/or complacency.

Crew monitoring performance can be significantly improved by developing and implementing effective SOPs to support monitoring and cross-checking functions, by training crews on monitoring strategies, and by pilots following those SOPs and strategies. This Appendix focuses on the first of these components, developing and implementing SOPs to improve monitoring.

A fundamental concept of improving monitoring is realizing that many crew errors occur when on or more pilots are off-frequency or doing heads-down work, such as programming a Flight Management System (FMS). The example SOPs below are designed to optimize monitoring by ensuring that both pilots are "in the loop" and attentive during those flight phases when weaknesses in monitoring can have significant safety implications.

Review and Modification of Existing SOPs

Some SOPs may actually detract from healthy monitoring. Operator should review existing SOPs and modify those that can detract from monitoring. For example, one air operator required a PA announcement when climbing and descending through 10,000 feet. This requirement had the unintended effect of "splitting the cockpit" at a time when frequency changes and new altitude clearances were likely. When the air operator reviewed its procedures it realized that this procedure detracted from having both pilots "in the loop" at a critical point and consequently decided to eliminate it.

Another operator required a company radio call to operations once the aircraft had landed. A critical review of procedures showed that this requirement, although sometimes necessary, had resulted in runway incursions because the first officer was concentrating on making this radio and not fully monitoring the captain's taxi progress. The procedure was modified so that crews make this call only when necessary and then only once all active runways are crossed, unless unusual circumstances warrant otherwise (such as extensive holding on the ground).

In addition to modifying existing SOPs, operators may consider adding sections to the SOP manual to ensure that monitoring is emphasized, such as:

- High-level SOPs that an over-arching message that monitoring is a very important part of cockpit duties.

Examples:

A. The SOP document could explicitly state that monitoring is a primary responsibility of each crewmember.

Example:

Monitoring responsibility

The PF will monitor/control the aircraft, regardless of the level of automation employed.

The PM will monitor the aircraft and actions of the PF.

Rationale:

A. Several air operators have made this change because they feel it is better to describe what that pilot should be doing (monitoring) rather than what he/she is not doing (not flying).

B. Although some SOP documents do define monitoring responsibilities for the PF, this role is often not explicitly defined for the PM. In many cases non-monitoring duties, such as company-required paperwork, PA announcements, operating gear and flaps, are clearly spelled-out, but seldom are monitoring duties explicitly defined for each pilot.

SOPs to support monitoring during airport surface operations

Examples:

A. Both pilots will have taxi charts available. A flight crewmember - other than the pilot taxiing the aircraft – should follow the aircraft's progress on the aircraft diagram to ensure that the pilot taxiing the aircraft is following the instructions received from ATC.

B. Both pilots will monitor taxi clearance, with the PM typically required to write and then read-back the taxi clearance to mitigate against uncertainty. Captain/PF will verbalize to FO/PM any hold short instructions. FO/PM will request confirmation from captain/PF if not received.

C. When approaching an entrance to an active runway, both pilots will ensure compliance with hold short or crossing clearance before continuing with non-monitoring tasks (e.g. FMS programming, Airborne Communications Addressing and Reporting System (ACARS), company radio calls, etc.).

Rationale:

Pilot-caused runway incursions often involve misunderstanding, not hearing a clearance or spatial disorientation. These SOPs are designed to do several things.

A. The requirement for both pilots to have taxi charts out ensures that the pilot who is not actively taxiing the aircraft can truly back-up the pilot who is taxiing.

B. Requesting that both pilots monitor the taxi clearance and having the captain discuss any hold short instructions is a method to ensure that all pilots have the same understanding of the intended taxi plan.

C. The requirement to suspend non-monitoring tasks as the aircraft approaches an active runway allows both pilots to monitor and verify that the aircraft stops short of the specified holding point.

SOPs to support improved monitoring during vertical segments of flight (also refer to Appendix 3 of this SN, "ATC Communication and Altitude Awareness")

Examples:

A. PF should brief PNF when or where delayed climb/descent will begin.

B. Perform non-essential duties/activities during lowest workload periods such as cruise altitude or level flight.

C. When able, brief the anticipated approach prior to top-of-descent.

D. During the last 1,000 feet of altitude change both pilots should focus on the relevant flight instruments to ensure that the aircraft levels at the proper altitude. (When VMC one pilot should include scanning outside for traffic; however, at least one pilot should focus on ensuring that the aircraft levels at the proper altitude).

Rationale:

A study on crew monitoring revealed that three-quarters of the monitoring errors in that study occurred while the aircraft was in a vertical phase of flight, i.e. climbing, descending or approach. These SOP statements ensure that proper attention can be devoted to monitoring during vertical phases of flight.

A. The monitoring study highlighted that a number of altitude deviations occurred when crews were given an altitude crossing restrictions, but then failed to begin the descent in a timely manner. Briefing the anticipated top-of-descent point not only promotes healthy CRM, but also allows the other pilot to "back up" the planned descent point and ensure the descent begins at the proper point. Example" "We'll begin our descent at 80 DME."

B. Studies likewise show that in order to minimize the chance of a monitoring error, crews should schedule performance of non-essential duties/activities during the lowest workload periods, such as cruse altitude or level flight.

C. Briefing the anticipated instrument approach prior to descent from cruise altitude allows greater attention to be devoted to properly monitoring the descent because the crew is not having to divide attention between reviewing the approach and monitoring the descent. It also allows greater attention to be devoted to the contents of the approach briefing, which can increase situation awareness and understanding of the intended plan for approach and landing.

D. Many altitude deviations occur because pilots are not properly monitoring the level off.

This SOP statement is to ensure that pilots concentrate on ensuring the aircraft levels at the proper altitude, instead of being distracted by or performing non-monitoring tasks.

SOPs to support improved monitoring of automation

Examples:

A. Before flight, the routing listed on the flight release must be cross-checked against the ATC clearance and the FMS routing.

B. When making auto-flight systems inputs, comply with the following items in the acronym CAMI:

Confirm FMS inputs with the other pilot when airborne

Activate the input

Monitor mode annunciation to ensure the auto-flight system performs as desired

Intervene, if necessary.

C. During high workload periods FMS inputs will be made by the PNF, upon the request of PF. Examples of high workload include when flying below 10,000 feet and when within 1000 feet of level off or transition altitude.

D. Pilots should include scanning of the Flight Mode Annunciator as part of their normal instrument scan, especially when automation changes occur (e.g., course changes, altitude level off, etc.).

Rationale:

A. It is not unusual for the routing that is loaded in the FMS to be different from the routing assigned by ATC, especially in those cases where the flight plan is uplinked directly into the FMS, or when an FMS stored company route is used. Various studies have demonstrated that FMS programming errors made during preflight are not likely to be caught by flight crews during flight. Therefore, it is critical that these items be cross-checked before takeoff.

B. The above-mentioned monitoring study found that 30 percent of the monitoring errors in that study's dataset occurred when a crewmember was programming a Flight Management System (FMS). Another study showed that even experienced pilots of highly automated aircraft sometime fail to adequately check the Flight Mode Annunciator to verify automation mode status. The acronym "CAMI" can be used to help emphasized cross-checking of automation inputs, monitoring and mode awareness.

C. The statement concerning FMS inputs during high workload allows the PF to concentrate on flying and monitoring by simply commanding FMS inputs during highly vulnerable times. Several reports indicate problems with failure to level-off and failure to reset altimeters to proper settings. Therefore, the definition of "high workload" should include those vulnerable phases.

D. Automated flight guidance systems can have mode reversions and can sometimes command actions that are not anticipated by pilots. Therefore, pilots should include the Flight Mode Annunciator into their normal instrument scan. Special attention should be given to periods of course changes, altitude level off, etc.)

APPENDIX 6

LOSS OF CONTROL IN-FLIGHT (LOC-I)

Example

GUIDANCE ON DEVELOPING SOPS TO PREVENT LOSS OF CONTROL IN-FLIGHT (LOC-I)

Objective

This appendix aims to provide guidance to operators in the area of developing SOPs aimed at preventing LOC-I. It is premised upon:

- The knowledge of in-flight conditions that may eventuate into a LOC-I situation.
- Effective flight path management and consequently the avoidance of LOC-I situations through early recognition of cues that typically precede such scenarios.
- Standardised recovery techniques from LOC-I situations.

Background

A Loss of Control (LOC) is the result of an aircraft operating in a flight regime beyond that of the normal flight envelope, usually but not always at a high rate, thereby introducing an element of surprise for the flight crew involved. This is more commonly referred to as the “startle effect”, a physiological situation where pilots may over-react/control, in response to a sudden alert or warning.

Typically, LOC-I scenarios are not generic and may be induced by a number of different factors either distinctly or in combination. For example:

- Environmental: Mountain waves, severe turbulences, windshear and icing.
- Human factors: Spatial disorientation, fatigue, poor situational awareness and incapacitation.
- Technological: Malfunctioning flight control systems/instruments, automation failure/mismanagement, availability of flight-envelope protection features.
- Organisational: deficiencies in policies, procedures and training.

The contemporary approach to LOC-I thus far have primarily been through simulator training programmes, which focus upon the appropriate recovery techniques for different scenarios. However, there are issues associated with differences between simulator training and actual aircraft recoveries. A simulator may provide the basic fundamentals for upset recovery, but some realities such as positive or negative g’s, startle effect and environmental conditions are difficult or impossible to replicate. This then serves to emphasize the importance of utilising training programmes and available resources that support an in-depth knowledge and understanding of various undesirable aircraft states by flight crews. Combining this with practical SOPs that consider LOC-I prevention and management serves to achieve improved margins of safety by:

- Preventing a possible LOC-I scenario through the early recognition of available cues.
- Removing the element of surprise and thus minimize the hazardous outcomes associated with the “startle effect”.
- Ensuring use of the correct recovery technique with the anticipation of both expected and unexpected aircraft behavior.

Formulation of Standard Operating Procedures

The intention of this bulletin is to develop standardized practices that may be easily adapted by operators to prevent the onset of a LOC-I event. Consequently, procedural design must reflect the ability to recognize the circumstances from which a LOC-I may eventuate and thereafter, direct flight crew reactions to either prevent or recover.

Recognition

Most LOC-I situations arise from some form of trigger events, which serve as a distraction to the pilots. Some examples which may be a precursor to LOC-I are:

- Wake turbulence
- Wind shear/Microburst/Mountain wave
- Icing
- Aircraft technical fault/failure
- Unreliable airspeed indications
- Unusual attitudes

An appreciation of the LOC-I condition is achieved by defining it first. Typically, unusual aircraft states such as the Approach-to-Stall or Unusual Attitude (UA) contain a narrative of the condition. For example:

- Stalls: A condition when the aircraft Angle of Attach (AOA) exceeds a point where lift generation reduces. This depends on:
    - Aircraft configuration
    - Speed and altitude
    - Wing contamination

- Windshear: A weather phenomenon hazardous to flight especially when aircraft is close to the ground. The effect on airspeed and other parameters like rates of descent/climb may be severe, and SOPs must iterate the importance of correct immediate recovery actions when faced in such situations. Since takeoff and approach speeds are flown nearer to stall speeds, the effect of a drastic change in airspeed gives pilots litter time to recover.

- UA: Many LOC-I events occur due to aircraft being in an unusual attitude at different phases of flight. Findings from these accidents show that many pilots did not receive or were not proficient in, unusual/upset attitude recovery techniques. An unusual attitude situation may cause pilots to experience spatial disorientation and temporarily loss of control of an aircraft.

Recognition is achievable through a variety of channels, by the mental or physical/visual. The primary differences between these is that the former is achieved through projection and the latter from reaction. Ideally, projected recognition of the circumstances that may eventuate into a LOC-I event are the best form of prevention. For example:

- UA projection: TCAS display shows opposite direction traffic +1,000 feet vertical separation at 40NM in combination with direct headwind of 35 knots – projected recognition of potential wake-turbulence encounter. Mitigation achieved by applying Strategic Lateral Offset Procedure (SLOP). Potential UA LOC-I event averted.

- Windshear projection: Some indicators of the presence of windshear include, but are not limited to:
  - Predictive windshear warning systems (if installed).
  - Reports from preceding aircraft.
  - Surface or geographical peculiarities conductive to turbulence at low levels.
  - Frontal activity.
  - Microbursts and temperature inversion.

Reactive recognition arises when there are internal or external physical/visual cues. For example:

- Stall recognition: SOPs should highlight two main indicators of a stall
  - A stall aural alert – this gives warning to an impending stall.
  - Aircraft buffeting – vibrations of an airframe due to turbulent airflow over wing surfaces as aircraft reaches the stall AOA.

- Windshear recognition:
  - Windshear alert systems (if installed).
  - Flight parameters may also indicate windshear conditions. They include:
    - Rate of climb/descent > 500fpm fluctuation from the normal rates.
    - Unusual thrust lever/thrust indications for a climb/approach, for an extended period of time.
    - Indicated airspeed vector showing fluctuation of > 15kts.
    - Unusual pitch or drastic pitch changes required for climb/approach.

- UA: SOPs should highlight the use of the Primary Flight Display (PFD) as the main instrument to confirm a UA. This should be confirmed by cross-checking other instruments and performance indicators like Indicated Airspeed (IAS), rates of climb/descent, and thrust. PM should also callout “ATTITUDE”, to alert the PF to urgently take action.

- *Further unusual aircraft state recognition is available in the Airplane Upset Recovery Training Aid developed by a consortium of manufacturers, airlines and industry specialization groups.*

Not all LOC-I situations are foreseeable as in the example above. Aircraft faults or failures are highly unpredictable, and under such circumstances reactive recognition and subsequently the application of the correct recovery technique is required. For example:

- In 2005, a Boeing 777 suffered a failure in its ADIRU that resulted in a pitch-up, low-airspeed warning followed by a pitch-down and overspeed warning and finally another pitch-up and approach-to-stall scenario with stall warning and stick shaker activation. Unusual attitude recovery by the flight crew was executed by the flight crew who then maintained manual flight path management until landing safely.

Prevention

Prevention is best achieved by increasing flight crew awareness of the potential to encounter a LOC-I. As the potential to face a LOC-I situation is prevalent across all phases of flight under many sets of circumstances, it is insufficient to dedicate a stand-alone SOP that addresses the prevention and management of all perceivable scenarios. As such, periodic referencing and cross checking ought to be made throughout both normal and non-normal procedures when there is an increased susceptibility for a LOC-I scenario to occur. For example:

- Incorrect entry of the aircraft ZFW during final flight deck preparation would result in erroneous V-speed calculation, that may result in a LOC-I event.
- The selection of full TO/GA thrust immediately following an engine-failure after a de-rated thrust take-off should only be made if airspeed is above V_{MCA}. Barring any circumstance of a catastrophic engine failure, this would ensure sufficient controllability of the aircraft to avoid a LOC-I event.
- Primary reference and scanning of your flight instruments during adverse weather in IMC conditions is key to avoiding spatial disorientation and a potential LOC-I event.
- Flights encountering severe turbulence and/or weather conditions may result in unusual attitudes and LOC-I scenarios.
- Flight in severe icing conditions may result in the contamination of the critical airplane surfaces and consequently lead to a LOC-I event such as an aerodynamic stall.
- Ensuring the aircraft’s center of gravity (CG) is within limits by proper weight distribution and loading.
- The aircraft is trimmed correctly for takeoff.

Additionally, recent LOC-I events have revealed a series of commonly recurring contributing factors that are observed to impede flight crew performance, such as:

- Automation mismanagement: Automated systems and flight path management have underpinned the evolution of safety in aviation. However, despite relatively low-fallibility, an over-reliance and complacency upon automation may inhibit crew awareness and thus limit their preventative capacity.

- Ineffective monitoring: Active monitoring of the aircraft performance is essential to maintaining a level of situational awareness that would detect and prevent unusual aircraft states, such as a LOC-I scenario.
- Manual flying: Basic flying skills combined with an understanding of aerodynamic concepts are essential for the pilot to retain and practice so as to correctly anticipate, identify and recover from any LOC-I situation.

Recognition and preventative policies and procedures for LOC-I, such as what is described above, are only effective when combined with other key operator SOP frameworks such as Communication, Threat and Error Management, Automation Practices, Checklist Discipline and Crew Resource Management as a few examples.

Recovery

Recovery techniques are explicit and aircraft manufacturer designed. Deviation from these techniques is not recommended unless consultation and approval with the aircraft manufacturer is first sought. Examples of recovery technique include:

- Stall recovery: SOPs should emphasize on immediate recovery actions once a stall is recognized.
  - Reduce AOA (nose down) to “break” the stall; wings level. This helps to regain lift.
    - **Note:** reducing a loss of altitude is secondary to the reduction of AOA as the priority is to recover lift.
  - Use thrust (for speed) as required once stall is averted.

- Windshear escape manoeuvre: SOPs must stress that the best recovery, if possible is, avoidance. Pilots should constantly monitor prevailing conditions, and judge whether safety will be compromised if the flight continues.
  - Before takeoff:
    - Delay takeoff.
    - Request use of a longer runway if available.
    - Use maximum thrust available.
    - Brief PM to closely monitor pitch, Indicated Airspeed (IAS) and rate of climb during initial climb out.
  - In-flight windshear escape manoeuvre:
    - Disconnect autopilot and autothrust/throttle.
    - Aggressively move thrust levels to maximum level.
    - Pitch to a manufacturer-specified nose up attitude (follow the flight director).
    - Maintain wings level.
    - Do not change aircraft configuration until out of windshear.
    - PM monitor and callout pitch, IAS and rate of climb/descent.

- UA recovery: UA recovery actions must correspond to the appropriate situation/phase of flight. For example:
    - Nose low, high airspeed:
        - Disconnect A/P and A/Thrust.
        - Smoothly raise nose and fly wings level.
        - Reduce thrust levers to suitable setting (depending on IAS).
    - Nose high, low airspeed:
        - Disconnect A/P and A/Thrust.
        - Smoothly lower nose and fly wings level.
        - Advance thrust levers to suitable setting.

APPENDIX 7

CONTROLLED FLIGHT INTO TERRAIN (CFIT)

Introduction

The risk of CFIT must be effectively minimized at an organizational, individual and operational level by the application of sound risk management principles.

An organization should establish or provide:

- A positive learning safety culture supported at the highest levels of management
- CFIT hazard awareness training-including departure and destination hazard identification
- Flight training and checking program which focuses on CFIT risk mitigation
- A route and airport qualification program for the flight crew appropriate to the routes being flown
- Flight crew experience and pairing policies appropriate to the routes being flown
- A Fatigue Risk Management System (FRMS)
- Positive interaction with Air Navigation Service Providers to understand their service capabilities and limitations – such as minimum vector altitude, terrain masking, Minimum Safe Altitude Warning (MSAW) capability
- Aircraft equipment appropriate to the routes being flown
- Tailored (customized) approach charts to their flight crew which clearly identify:
    - that a particular instrument approach procedure is approved for use
    - the DA/H to be used by the flight crew prior to the application of corrections
- A non-punitive incident reporting program
- A non-punitive missed approach / diversion policy
- Safety education and promotional material

An assessment of an organization’s capacity and performance in these areas by the flight crew will assist in establishing a baseline CFIT risk for each route to be further managed in accordance with the standard operating procedures according to circumstance.

It must be emphasized that even where an organization’s aircraft, systems, culture, policy, procedures and practices are excellent, they cannot fully mitigate human factors. Human factors which have contributed to CFIT events include: fitness to fly, fatigue, cockpit authority gradients, groupthink, language (communication) difficulties, loss of situational awareness, and rushing due to a perception of time pressure (for commercial or other reasons). Such factors need to be managed by the flight crew themselves in accordance with Crew Resource Management (CRM) principles. However, they cannot be managed unless crew members speak up whenever they have concerns or are in doubt about the safety of flight.

Guidance for the development of Standard Operating Procedure (SOP) to minimize the risk of CFIT

The following topics should be addressed in an organization's operations manual. This is not a prescriptive or limited list. Operators must consult all relevant Civil Aviation Administration, Original Equipment Manufacturer (OEM), and advisory materials to develop standard operating procedures specific to their operation.

Standard Operating Procedures shall encompass:

Automation

1. The automation use philosophy
2. Limitations on coupling the autopilot to flight guidance systems
3. Use of automation as appropriate to the task
4. Flight Management System / Flight Director / Autopilot: interaction, degradations and reversions
5. The monitoring and read out of Flight Mode Annunciator (FMA) changes and alerts by flight crew

Altimetry

1. Awareness of significant terrain along departure, en-route and approach path
2. Awareness of definitions and use of Minimum Obstacle Clearance Altitude (MOCA), Minimum Off-Route Altitude (MORA), Minimum Safe Altitude (MSA) and Minimum En-route Altitude (MEA)
3. Ensuring use of the correct barometric subscale
4. Actions at transition altitude / level
5. International differences in transition altitude / level
6. Altitude awareness crew callouts / crew response to auto callouts
7. Use of 500 ft. altitude call during Non-Precision Approach (NPA)
8. Components of total altimeter system error
9. Application of the appropriate corrections to Minimum Descent Altitude (MDA) for wind and temperature
10. Monitoring aircraft rate of climb / descent during last 1000 feet of altitude change
11. Optimum use of and limitations of radio altimeter
12. Conduct of metric operations

Contingencies

1. The effect of system failures on an aircraft's navigation capability
2. The effect of system failures on the operating minima and / or the aircraft's approach and go around capability
3. The effect of engine failure on aircraft performance with respect to terrain
4. Definition of escape routes for depressurization and / or engine failure contingencies

5. Use of secondary flight planning functions to facilitate transition to an escape route
6. Procedure to recover from automation failure
7. Response to Ground Proximity Warning System (GPWS) alert / warning
8. Response to an Air Traffic Control (ATC) initiated MSAW warning
9. Response to the loss of Global Navigation Satellite System (GNSS) during an approach procedure

Flight Crew

1. Timely review of approach or departure procedure charts
2. Timely conduct of departure and approach briefing. The briefing content to include:
    a. Location specific CFIT risk stated / addressed
    b. Location specific crew qualification considered
    c. Statement regarding fitness to fly, level of fatigue and other human factors
    d. MDA corrections to be applied
    e. Avoidance of rushed approaches
    f. Statement of the expected departure and climb profile (gradient)
    g. Statement of special take off procedure in the event of engine failure
    h. Statement of the expected descent and approach profile (gradient)
    i. Statement of the expected meteorological conditions
    j. Statement of the aircraft configuration which will best enable compliance with departure or approach constraints
    k. Expected aircraft heading and attitude at MDA
    l. Statement of missed approach procedure to be followed in the event of an engine failure
    m. Approach monitoring philosophy
    n. Actions and callouts when approach ‘gates’ are missed
3. Using ATC as a ‘crew resource’ as appropriate
4. Using engineer or pilot occupying jump seat as a crew resource
5. Flight deck discipline-reminder to fly as trained
6. Pilot Flying (PF) / Pilot Monitoring (PM) duties and responsibilities clearly documented
7. Sterile cockpit definitions and application
8. Maintaining vigilance – situational awareness
9. Monitoring / cross checking

Navigation

1. The capability and limitation of the aircraft’s navigation system
2. Accurate interpretation of information shown on the departure and approach charts
3. Appropriate use of Electronic Flight Instrument System (EFIS) range and mode selection
4. Appropriate use of Enhanced Ground Proximity Warning System (EGPWS), aka Terrain Awareness Warning System (TAWS)
5. Appropriate use of weather and ground radar systems

6. Instrument approach procedure design criteria
7. International difference in chart design: PANS-OPS vs TERPS
8. The type of operation and airspace classes for which the navigation system is approved
9. Functional integration of navigation system with other aircraft systems
10. Verification that the navigation system self-tests satisfactorily
11. Verification that the aircraft navigation database is current
12. Initialization of Flight Management Guidance System (FMGS)
13. Verification of the accuracy of the navigation system
14. Cross checking active flight route as entered in the FMGS with the actual ATC clearance
15. Fly direct to / intercept a track / accept vectoring / rejoin approach procedure
16. De-selection / re-selection of navigation aids
17. Perform gross navigation error checks using conventional navigation aids
18. The effect of bank angle restrictions on aircraft's navigation capability
19. The effect of groundspeed on navigation performance
20. Contingency procedures for navigation system failures
21. Components of total navigation system error
22. Determination of cross-track error / deviation
23. Position update logic and priority
24. Performance issues associated with reversion to radio updating and limitations on the use of DME and VOR updating
25. Dealing with a map shift-position recalculation and update

Operations

1. Use of precision approach procedures when appropriate
2. Avoiding false capture of Localizer (LOC) and or Glideslope
3. Use of a Constant Descent Final Approach (CDFA) technique
4. The requirement to observe the speed constraints in radius to fix (RF) legs
5. Definition of and application of stabilized approach criteria
6. Determination of MSA and MDA
7. Use of Minimum Vector Altitudes (MVA) when provide by ATC
8. Checking crossing altitudes at Initial Approach Fix (IAF) positions
9. Checking crossing altitudes and glideslope centering at Final Approach Fix (FAF)
10. Independent verification by PM of minimum altitude during step-down VOR/DME, LOC/DME approach
11. The appropriate use of auto-thrust / manual thrust to manage airspeed
12. Appropriate aircraft configuration to allow compliance with bank angle or speed restrictions during an approach or missed approach